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Helminths of Squirrels (Sciuridae) from Mongolia

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Abstract

Two species of ground squirrels, *Urocitellus undulatus* and *Spermophilus alashanicus*, were collected and examined for parasites from two localities in Mongolia in 1999. A total of 24 individuals of *U. undulatus* were examined resulting in a total of six taxa of helminths found, including: *Ascaris tarbagan*, *Physaloptera massino*, *Streptopharagus kutassi*, *Anoplocephaloides transversaria*, *Hymenolepis suslica*, and *Moniliformis* sp. This represents four new species records and an additional host record for the country. Two individuals of *S. alashanicus* were examined and found to be uninfected.

Key words.—acanthocephala, cestode, helminth, Mongolia, nematode, *Spermophilus*, squirrel, *Urocitellus*

Introduction

The geographic distribution of the long-tailed ground squirrel, *Urocitellus undulatus* (Pallas 1778) extends through a wide band of central Asia including suitable habitats in Kazakhstan across southern and eastern Siberia through Mongolia and into northern China (Tinnin et al. 2002). Although patchy in occurrence through this region, these squirrels are found in great abundance in some areas with numerical densities sometimes exceeding 18 individuals/hectare (ha) (Tinnin 2002) with some observers reporting very high densities of "…hundreds all over the plains" (Allen 1940).

Published information on endoparasites of *U. undulatus* has also historically been patchy in time and space. In Mongolia, four species of helminths have been reported from this host: *Ctenotaenia marmotae* (Frölich 1802); *C. citelli* (Kirshenblat 1939), which some authors consider to be synonymous with *C. marmotae*; *Mesocestoides* sp.; and *Moniliformis moniliformis* (Bremser 1811) (see Danzan 1978; Ganzorig et al. 1988; Ganzorig et al. 1998; Ganzorig et al. 2007). Tokobaev (1976) reports the finding of two helminths, *Trichuris citellorum* (Kirshenblat 1939) and *Ctenotaenia citelli,* from Kazakhstan.

In contrast, there have been nine publications that examined the parasite fauna of the long-tailed ground squirrel in eastern Siberia, reporting 35 species of helminths. Six of these are surveys from the region of Lake Baikal (Machulskii 1958; Nadtochi et al. 1966; Eltyshev and Maklokova 1971; Eltyshev 1975; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990). The three additional papers were each a single species description from the regions of Tuva (Sulimov 1961a, 1961b) and Yakutsia (Ryzhikov 1956).

The Alashan ground squirrel, *Spermophilus alashanicus* Büchner 1888, in comparison has a rather restricted range across the Ala Shan Mountains of northwestern China and the Gobi Altai Mountains of southern Mongolia. However, the literature seems to indicate that they have never previously been examined for parasites.

From 9 July through 2 August 1999, small mammals were collected from 13 sites as part of a survey of small mammal and parasite diversity in Mongolia (Tinnin et al. 2002; Tinnin et al. 2008). The results of the examination for helminths of 24 individuals of *Urocitellus undulatus* and two individuals of *S. alashanicus* are presented in this study.

MATERIALS AND METHODS

Squirrels were collected from two localities in Mongolia in July 1999. The first site, Ulaan Tsutgaalan (46°47'13"N, 101°57'47"E; 1,850 m elevation), is located in the Khangai Mountains of Övörkhangay Aimag (Province) in west central Mongolia. The surrounding area is rocky mountain steppe habitat cut through by the Orkhon River. The river canyon (ca. 200 m wide by 50 m deep) is steep sharply cut rock with a mixed *Pinus*, *Populus*, and *Larix* forest along the riverbank. At this site, 24 *Urocitellus undulatus* were collected and examined for parasites. The second site, Ulziyt Uul (44°41'09"N, 102°00'57"E; 1,640 m elevation), is a small barren rocky hill in the arid Gobi Steppe north of Arts Bogd Mountain. The area consists of sparse vegetation (*Allium*, *Stipa*, and *Artemesia*) and desert pavement. Two individuals of *S. alashanicus* were examined for parasites from this locality.

Animals were processed immediately after capture following standard protocols (Gardner 1996). Each animal was killed with chloroform, brushed, and examined for ectoparasites, a blood smear was made for later examination for microfilariae or hemoprotozoa, and fecal samples were collected for study of coccidia following the method of Vance and Duszynski (1985) and Gardner (1996). The complete GI tract was removed, and the liver, lungs, and the pleural and peritoneal cavities were examined for helminths. Each organ was opened and examined separately for helminths. Gastrointestinal tracts of eight individuals of *U. undulatus* were preserved in 70% ETOH until examined in the Manter Laboratory of Parasitology. From complete field necropsies, parasite specimens were preserved in 10% formalin or 70% ETOH for study by light microscopy. Cestode specimens were stained with carmine, mounted with damar gum and observed with a light microscope. Nematode specimens were preserved in 10% formalin cleared in lactophenol and observed with a light microscope.

Mammals used in this study have been deposited in the Museum of Southwestern Biology (MSB) as reported by Tinnin et al. (2002).

RESULTS

A total of six taxa of helminths was collected from 16 of the 24 individuals of *U. undulatus* examined. Both of the individuals of *S. alashanicus* examined were uninfected. Parasite, locality, and infection parameters for the *U. undulatus* specimens are outlined below.

NEMATA
Ascaris tarbagan Schulz 1931

Collection locality.—Ulaan Tsutgaalan.

Site of infection.—Small intestine.

Prevalence and intensity.—6/24 (25%), 3.8 (1-13).

Specimens deposited.—HWML 62986, 62988, 62997, 63004, 66692, 66697, 66698, 66699, 66705.

Additional host from Mongolia.—Marmota sibirica (Radde 1862) from near Baruun-Urt, Sukhbaatar Aimag in eastern Mongolia (Meszaros 1974).

Type host and type locality.—*Marmota sibirica* from the vicinity of Chita, Russia (Schulz 1931).

Other reported hosts.—*Ascaris tarbagan* is common in marmots across central Asia and southern Siberia. It has been reported from: *Marmota menzbieri* (Kashkarov 1925); *M. caudata* (Geoffroy 1844); *M. baibacina* Kastchenko 1889; and *M. sibirica* (Schulz 1931) (Spasski et al. 1950; Machulskii 1958; Yamaguti 1961; Barus et al. 1970; Ismatov 1970; Tokobaev 1976; Zhaltsanova and Shalaeva 1990). It also has been reported from *M. monax* (Linnaeus 1758) in Alaska (Phillip 1938) and is commonly found in *Urocitellus undulatus* in Russia (Eltyshev and Maklokova 1971; Eltyshev 1975; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990).

Geographic range.—This species has been reported from Afghanistan (Barus et al. 1970), Tadjikhistan (Ismatov 1970), southern Kazakhstan (Spasski et al. 1950), several locations in southern Russia in the regions of Lake Baikal and Buryatia (Machulskii 1958; Eltyshev and Maklokova 1971; Eltyshev 1975; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990) into eastern Mongolia (Meszaros 1974). There is also one report of this species from Alaska (Phillip 1938).

Physaloptera massino Schulz 1926

Collection locality.—Ulaan Tsutgaalan.

Site of infection.—Small intestine and stomach.

Prevalence and intensity.—6/24 (25%), 4 (1-11).

Specimens deposited.—HWML 62985, 66694, 66697, 66698, 66699, 66704, 66710, 66711, 66712.

Additional host from Mongolia.—This represents the first record for the country.

Type host and type locality.—*Mus musculus* Linnaeus 1758 from Bukhara, Uzbekistan (Morgan 1943).

Other reported hosts.—*Rhombomys opimus* (Lichtenstein 1823); *Apodemus sylvaticus* (Linnaeus 1758); *Meriones meridianus* (Pallas 1773); *Marmota sibirica*; *Sciurus niger* Linnaeus 1758; *Urocitellus undulatus*; *Ictidomys tridecemlineatus* (Mitchill 1821); *Poliocitellus franklini* (Sabine 1822); and *Tamias sibiricus* (Laxmann 1769) (Morgan 1943; Chabaud 1956; Yamaguti 1961; Skrjabin and Sobolev 1964; Tokobaev 1976; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990; Coyner et al. 1996).

Geographic range.—This species has been reported from across central Asia including Kazakhstan and Uzbekistan (Skrjabin and Sobolev 1964; Tokobaev 1976), Russia (Morgan 1943; Yamaguti 1961; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990), and North America including Canada and Florida (Morgan 1943; Yamaguti 1961; Coyner et al. 1996).

Remarks.—Some authors believe that *P. spinicauda* MacLeod 1933, the form found in *I. tridecemlineatus* and *P. franklini* in North America, is a distinct species (Chabaud 1956; Skrjabin and Sobolev 1964), while others have recognized it as a synonym of *P. massino* (see Morgan 1943; Yamaguti 1961).

Streptopharagus kutassi (Schulz 1927) Kirshenblat 1949
(Syn. *Arduenna kutassi* Schulz 1927)

Collection locality.—Ulaan Tsutgaalan.

Site of infection.—Small intestine and stomach.

Prevalence and intensity.—4/24 (16.7%), 16 (1-49).

Specimens deposited.—HWML 62985, 66695, 66697, 66698, 66699, 66710.

Additional host from Mongolia.—This represents the first record for the country.

Type host and type locality.—*Spermophilus pygmaeus* (Pallas 1778) from Ukraine.

Other reported hosts.—*Spermophilus pygmaeus*; *S. citellus* (Linnaeus 1766); *S. fulvus* (Lichtenstein 1823); *S. relictus* (Kashkarov 1923); *S. xanthoprymnus* (Bennet 1835); *U. undulatus*; *Spermophilopsis*

leptodactylus (Lichtenstein 1823); *Marmota bobac*; *M. caudata*; *M. menzbieri*; *Tamias sibiricus*; *Mesocricetus brandti* (Nehring 1898); *Cricetulus migratorius* (Pallas 1773); *Acomys dimidiatus* (Crezschmar 1826); *Meriones crassus* Sundevall 1842; *M. meridianus* (Pallas 1773); *M. persicus* (Blanford 1875); *M. lybicus* Lichtenstein 1823; *Allactaga severtzovi* Vinogradov 1925; *Gerbillus gerbillus* (Olivier 1801); *Sekeetamys calurus* (Thomas 1892); *Rattus rattus* (Linnaeus 1758); and *Vulpes corsac* (Linnaeus 1768) (Chabaud 1954; Simitch and Petrovich 1954; Yamaguti 1961; Skrjabin et al. 1967; Barus et al. 1970; Wertheim and Greenberg 1970; Tokobaev 1976; Mas-Coma and Feliu 1984; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990; Wertheim 1993).

Geographic range.—This species had been reported from eastern Europe and the Mediterranean (Bernard 1964; Mas-Coma and Feliu 1984), into the Middle East (Chabaud 1954; Wertheim and Greenberg 1970), and across Russia and Central Asia (Yamaguti 1961; Skrjabin et al. 1967; Barus et al. 1970; Tokobaev 1976; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990).

Remarks.—Tenebrionid beetles have been reported as hosts for larval *S. kutassi* in Tadjikistan (Gafurov 1968, 1970), Turkmenistan (Mushkambarova 1973; Minailova 1976), and the Mediterranean (Theodorides 1955).

CESTODA

Anoplocephaloides transversaria (Krabbe 1879) Baer 1924

(Syn. *Taenia transversaria* Krabbe 1879; *Anoplocephala transversaria* (Krabbe 1879) Blanchard 1891; *Paranoplocephala transversaria* (Krabbe 1879) Baer 1927)

Collection locality.—Ulaan Tsutgaalan.

Site of infection.—Small intestine.

Prevalence and intensity.—1/24 (4.2%), 5.

Specimens deposited.—HWML 49553, 49554, 62987.

Additional host from Mongolia.—This represents the first record for the country.

Type host and type locality.—*Marmota* sp. from Turkestan (southern slope of the Talasskii Alatau; likely in modern Kirghizia) (Spasski et al. 1950).

Other reported hosts.—*Marmota sibirica*; *M. baibacina*; *M. marmota*; *M. menzbieri*; *M. caudata*; *M. himalayana* (Hodgson 1841); and *Urocitellus undulatus* (Spasski et al. 1950; Sulimov and Obukhov 1975; Tokobaev 1976; Guan and Lin 1991; Lin et al. 1982; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990).

Geographic range.—This species is found from Europe (Yamaguti 1959) across Southern Siberia (Sulimov and Obukhov 1975; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990), Central Asia (Spasski et al. 1950; Yamaguti 1959; Tokobaev 1976), and into China (Lin et al. 1982; Guan and Lin 1991).

Hymenolepis suslica Shaldybin 1965

Collection locality.—Ulaan Tsutgaalan.

Site of infection.—Small intestine.

Prevalence and intensity.—6/24 (25%), 4.7 (1-11).

Specimens deposited.—HWML 49555, 49556, 49557, 49558, 62989, 63002, 63003, 66693, 66696, 66700, 66706, 66713.

Additional host from Mongolia.—This represents the first record from the country.

Type host and type locality.—*Spermophilus suslica* (Güldenstaedt 1770) from the Gorky (Nizhny Novgorod) Oblast, Russia (Shaldybin 1965).

Other reported hosts.—*Urocitellus undulatus* (see Zhaltsanova and Shalaeva 1990).

Geographic range.—This species previously has been reported from Russia and southern Siberia

(Shaldybin 1965; Zemlyanova 1981; Zhaltsanova and Shalaeva 1990).

ACANTHOCEPHALA
***Moniliformis* sp.**

Collection locality.—Ulaan Tsutgaalan.

Site of infection.—Small intestine.

Prevalence and intensity.—1/24 (4.17%), 1.

Specimens deposited.—HWML 66708.

Remarks.—One individual in poor condition was recovered from the alcohol preserved GI tracts that were examined at a later date in the laboratory.

Moniliformis clarki (Ward 1917) has been reported from *Phodopus campbelli* (Thomas 1905), *Allocricetulus curtatus* (Allen 1925), *Marmota sibirica*, and *U. undulatus* in Mongolia (Danzan 1978; Ganzorig 1998; Tinnin et al. 2008).

Moniliformis moniliformis (Bremser 1811) has been previously reported from *H. auritus*, *Mesechinus dauuricus* (Sundevall 1842), *Urocitellus undulatus* (Pallas 1778), *Spermophilus erythrogenus* Brandt 1841, *Meriones meridianus* (Pallas 1773), and *Microtus arvalis* (Pallas 1778) (see Danzan 1978; Ganzorig et al. 1988). Some of the previous reports of *M. moniliformis* in *U. undulatus* may in fact represent *M. clarki* (see Ganzorig 1998; Tinnin et al. 2008).

Moniliformis clarki has been reported from *Scalopus aquaticus* (Linnaeus 1758), *Parascalops breweri* (Bachman 1842), *U. undulatus*, *Spermophilus pygmaeus*, *I. tridecemlineatus* (Mitchill 1821), *Glaucomys volans* (Linnaeus 1758), *Sciurus niger*, *Sciurus carolinensis* Gmelin 1788, *Tamias striatus* (Linnaeus 1758), *Geomys bursarius* (Shaw 1800), *Microtus ochrogaster* (Wagner 1842), *Microtus pinetorum* (Le Conte 1830), *Microtus pennsylvanicus* (Ord 1815), *Microtus montebelli* (Milne-Edwards 1872), *Onychomys leucogaster* (Wied-Neuwied 1814), *Onychomys torridus* (Coues 1874), *Apodemus speciosus* (Temminck 1844), *Rattus norvegicus* (Berkenhout 1769), *R. rattus* (Linnaeus 1758), *Ochotona dauurica* (Pallas 1776), *Ochotona pallasi* (Gray 1867), and *Mustela eversmanni* Lesson 1827 (Doran 1954; Yamaguti 1963; Gvozdev et al. 1970; Buckner and Nickol 1975; Tokobaev 1976; Ipateva and Kozlova 1980; Pfaffenberger et al. 1985; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990; Amin and Pitts 1996; Pung et al. 2000). This species has been reported from India (Buckner and Nickol 1975), Kazakhstan (Gvozdev et al. 1970; Tokobaev 1976), Siberia (Gvozdev et al. 1970; Sulimov and Obukhov 1974; Sulimov et al. 1974; Ipateva and Kozlova 1980; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990), Japan (Yamaguti 1963), as well as North America (Ward 1917; Yamaguti 1963; Buckner and Nickol 1975; Pfaffenberger 1985; Amin and Pitts1996; Coyner et al. 1996; Pung et al. 2000).

Moniliformis moniliformis has been reported from a variety of insectivorous and carnivorous mammals across Eurasia, Africa, and Pacific Islands (Yamaguti 1963; Tokobaev 1976; Deveaux et al. 1988).

DISCUSSION

The results of this study, even with a limited number of additional specimens collected during the field season in 1999, increases the known number of helminths from the long-tailed ground squirrel in Mongolia from four to ten. Previous reports have included *Ctenotaenia marmotae*, *C. citelli*, *Mesocestoides* sp., and *Moniliformis moniliformis*, which may in fact have represented *M. clarki* (see Danzan 1978; Ganzorig et al. 1988; Ganzorig et al. 1998; Ganzorig et al. 2007). Four of the species reported in this study (*Physaloptera massino*, *Streptopharagus kutassi*, *Anoplocephala transversaria*, and *Hymenolepis suslica*) represent new records for the country. The addition of these four species increases the known helminths from small mammals within the country by approximately 10%. The fifth species related herein (*Ascaris tarbagan*) is a new host record, doubling the known hosts for this parasite within Mongolia.

Outside of Russia, the only other records are by Tokobaev (1976) who reported the finding of two helminths, *Trichuris citellorum* and *Ctenotaenia citelli,* from Kazakhstan. Previous work conducted in Russia, almost exclusively near Lake Baikal, reports 35 species of helminths from *Urocitellus undulatus.* One species of trematode, *Plagiorchis eutamiatis* Schulz 1932, is known (Eltyshev 1975). Three species of Acanthocephala, *Moniliformis clarki* (Ward 1917), *M. moniliformis* (Bremser 1811), and *Macracanthorhynchus catulinus* Kostylew 1927, have been reported (Machulskii 1958; Eltyshev 1975; Shalaeva et al. 1987). Twelve species of cestode, *Aprostandrya macrocephala* (Douthitt 1915), *Catenotaenia cricetorum* Kirshenblat 1949, *Ctenotaenia citelli* (Kirshenblat 1939), *Taenia solium* (larval) Linnaeus 1758, *Echinococcus multilocularis* (larval) Leuckart 1863, *Hymenolepis diminuta* (Rudolphi 1819), *Hymenolepis megaloon* (Linstow 1901), *Hymenolepis suslica* Shaldybin 1965, *Mesocestoides lineatus* (larval) (Goeze 1782), *Paranoplocephala brevis* Kirschenblat 1938, *Anoplocephaloides dentata* (Galli-Valerio 1905), and *Anoplocephaloides transversaria* (Krabbe 1879), have been reported (Machulskii 1958; Eltyshev and Maklokova 1971; Eltyshev 1975; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990). Nineteen species of nematode, *Abbreviata leiperi* (Skrjabin 1924), *Ascaris tarbagan* Schulz 1931, *Ascaris joffi* Schulz 1931, *Ascarops tuvensis* Sulimov 1961, *Baylisascaris laevis* (Leidy 1856), *Capillaria armeniaca* Kirschenblat 1939, *Capillaria sibirica* Romanov 1960, *Mastophorus muris* (Gmelin 1790), *Physaloptera citilli* (Rudolphi 1819), *Physaloptera massino* Schulz 1926, *Physaloptera soricina* (Baylis 1934), *Protospirura suslica* Schulz 1928, *Streptopharagus kutassi* (Schultz 1927), *Subulura citelli* Sulimov 1961, *Syngamus citelli* Ryzhikov 1956, *Syphacia obvelata* (Rudolphi 1802), *Trichinella spiralis* (Owen 1835), *Trichuris citellorum* (Kirshenblat 1939), and *Trichostrongylus colubriformes* (Giles 1892), have been reported (Ryzhikov 1956; Machulskii 1958; Sulimov 1961a, 1961b; Nadtochi et al. 1966; Eltyshev and Maklokova 1971; Eltyshev 1975; Shalaeva et al. 1987; Zhaltsanova and Shalaeva 1990).

There is considerable overlap in the known helminth species harbored by *U. undulatus* across its range. However, fauna from any particular locality or habitat vary considerably in terms of both presence and prevalence. Across the Baikal Basin, the number of helminths present in any locality varied from two to ten species, while only a few species were present in more than one or two localities. This would indicate that the examinations of additional specimens from numerous and varied locations across Mongolia, where a large part of the range of this ground squirrel occurs, is required to improve our understanding of the helminth fauna of this species as well as that of the country in general.

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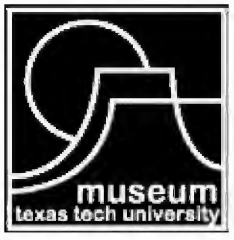

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